

What is claimed is:

1. A MEMS optical component formed on a ¹⁰⁴integrated MEMS chip oriented in a horizontal plane, the MEMS optical component comprising:

an element structure assembly comprising:

5 a corresponding actuator mechanism ¹²⁰formed on the integrated MEMS chip, the corresponding actuator mechanism being configured to be controlled to move laterally on the integrated MEMS chip;

an element structure ¹¹⁵formed on and pivotally coupled to the integrated MEMS chip and moveably coupled to the corresponding actuator mechanism ¹²⁰, the element structure having a lying position generally parallel to the horizontal plane and an upright position generally perpendicular to the horizontal plane, the element structure ¹¹⁵comprising an optical element that is configured to optically interact with an input light beam when in the upright position;

10 wherein, when the corresponding actuator mechanism ¹²⁰is controlled to move laterally, the element structure pivots so as to move from the lying position to the upright position so that the optical element optically interacts with the input light beam.

2. The MEMS optical component of claim 1 wherein the element structure assembly further comprises:

20 a corresponding first hinge configured to pivotally couple the element structure to the insulating layer;

a corresponding support arm, a corresponding second hinge, and a corresponding third hinge configured to moveably couple the element structure to the corresponding actuator mechanism, the corresponding second hinge being configured to pivotally couple a first end of the corresponding support arm to the corresponding actuator mechanism, the corresponding third hinge being configured to pivotally couple a second end of the corresponding support arm to the element structure.

3. The MEMS optical component of claim 2 wherein the MEMS optical component is monolithically fabricated on the integrated MEMS chip.

4. The MEMS optical component of claim 1 further comprising a locking latch assembly, the locking latch assembly comprising:

5 a corresponding actuator mechanism formed on ^{NA}the insulating layer, the corresponding actuator mechanism being configured to be controllably moved laterally with respect to ^{NA}the insulating layer;

a locking latch pivotally coupled to ^{NA}the insulating layer and moveably coupled to the corresponding actuator mechanism, the locking latch having a slot sized to closely receive a side of the element structure, the locking latch having a lying position parallel to ^{NA}the insulating layer and a locking position in which the slot receives the side of the element structure when the element structure is in the upright position;

wherein, when the corresponding actuator mechanism is controlled to move laterally, the locking latch pivots so as to move from the lying position to the locking position.

15 5. The MEMS optical component of claim 1 wherein:
the element structure assembly further comprises:

a corresponding first hinge configured to pivotally couple the element structure to ^{NA}the insulating layer;

a corresponding support arm, a corresponding second hinge, and a corresponding third hinge configured to moveably couple the element structure to the corresponding actuator mechanism, the corresponding second hinge being configured to pivotally couple a first end of the corresponding support arm to the corresponding actuator mechanism, the corresponding third hinge being configured to pivotally couple a second end of the corresponding support arm to the element structure; and

25 (the locking latch assembly) ^{NA} further comprises:

a corresponding first hinge configured to pivotally couple ^{NA}the locking latch to

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a corresponding support arm, a corresponding second hinge, and a corresponding third hinge configured to moveably couple ^{NA}the locking latch to the corresponding actuator mechanism of ^{NA}the locking latch assembly, the corresponding second hinge being configured to pivotally couple a first end of the corresponding support arm to the
5 corresponding actuator mechanism of ^{NA}the locking latch assembly, the corresponding third hinge being configured to pivotally couple a second end of the corresponding support arm to ^{NA}the locking latch.

6. The MEMS optical component of claim 5 wherein the MEMS optical component is monolithically fabricated on the integrated MEMS chip.

7. An optical device integrated on ^Ma integrated MEMS chip, the integrated MEMS chip being oriented in a horizontal plane, the optical device comprising one or more MEMS optical components, each of the MEMS optical components comprising:

an element structure assembly comprising:

a corresponding actuator mechanism formed on the integrated MEMS chip, the corresponding actuator mechanism being configured to be controlled to move laterally on the integrated MEMS chip;

an element structure formed on and pivotally coupled to the integrated MEMS chip and moveably coupled to the corresponding actuator mechanism, the element structure having a lying position generally parallel to the horizontal plane and an upright position generally perpendicular to the horizontal plane, the element structure comprising an optical element that is configured to optically interact with an input light beam when in the upright position;

wherein, when the corresponding actuator mechanism is controlled to move laterally, the element structure pivots so as to move from the lying position to the upright position so that the optical element can optically interact with the input light beam.

8. The optical device of claim 7 wherein the element structure assembly of each MEMS optical component further comprises:

a corresponding first hinge configured to pivotally couple the element structure to (the insulating layer),^{NA} ✓

5 a corresponding support arm, a corresponding second hinge, and a corresponding third hinge configured to moveably couple the element structure to the corresponding actuator mechanism, the corresponding second hinge being configured to pivotally couple a first end of the corresponding support arm to the corresponding actuator mechanism, the corresponding third hinge being configured to pivotally couple a second end of the
10 corresponding support arm to the element structure.

✓ 9. The optical device of claim 8 wherein each of the MEMS optical components is monolithically fabricated on the integrated MEMS chip.

10. The optical device of claim 7 wherein each of the MEMS optical components further comprises a locking latch assembly, the locking latch assembly comprising:

✓ 15 a corresponding actuator mechanism formed on (the insulating layer),^{NA} the corresponding actuator mechanism being configured to be controllably moved laterally with respect to the insulating layer, ✓

20 a locking latch pivotally coupled to (the insulating layer) and moveably coupled to the corresponding actuator mechanism, the locking latch having a slot sized to closely receive a side of the element structure, the locking latch having a lying position parallel to the insulating layer and a locking position in which the slot receives the side of the element structure when the element structure is in the upright position;

wherein, when the corresponding actuator mechanism is controlled to move laterally, the locking latch pivots so as to move from the lying position to the locking position.

the element structure assembly of each of the MEMS optical components further comprises:

a corresponding first hinge configured to pivotally couple the element structure to (the insulating layer);

5 a corresponding support arm, a corresponding second hinge, and a corresponding third hinge configured to moveably couple the element structure to the corresponding actuator mechanism, the corresponding second hinge being configured to pivotally couple a first end of the corresponding support arm to the corresponding actuator mechanism, the corresponding third hinge being configured to pivotally couple a second end
10 of the corresponding support arm to the element structure; and

the locking latch assembly of each of the MEMS optical components further comprises:

a corresponding first hinge configured to pivotally couple the locking latch to (the insulating layer);

15 a corresponding support arm, a corresponding second hinge, and a corresponding third hinge configured to moveably couple the locking latch to the corresponding actuator mechanism of the locking latch assembly, the corresponding second hinge being configured to pivotally couple a first end of the corresponding support arm to the corresponding actuator mechanism of the locking latch assembly, the corresponding third
20 hinge being configured to pivotally couple a second end of the corresponding support arm to the locking latch.

✓ 12. The MEMS optical component of claim 11 wherein each of the MEMS optical components is monolithically fabricated on the integrated MEMS chip.

13. An optical network comprising:

25 one or more optical input sources;

one or more optical output collectors; and

an optical device optically coupled between the one or more optical input sources and the one or more optical output collectors, the optical device being formed on a^m integrated MEMS chip, the integrated MEMS chip being oriented in a horizontal plane, the optical device comprising one or more MEMS optical components, each of the MEMS optical components comprising:

an element structure assembly comprising:

a corresponding actuator mechanism formed on the integrated MEMS chip, the corresponding actuator mechanism being configured to be controlled to move laterally on the integrated MEMS chip;

an element structure formed on and pivotally coupled to the integrated MEMS chip and moveably coupled to the corresponding actuator mechanism, the element structure having a lying position generally parallel to the horizontal plane and an upright position generally perpendicular to the horizontal plane, the element structure comprising an optical element that is configured to optically interact with an input light beam when in the upright position;

wherein, when the corresponding actuator mechanism is controlled to move laterally, the element structure pivots so as to move from the lying position to the upright position so that the optical element can optically interacting with the input light beam.

14. The optical network of claim 13 wherein the element structure assembly of each MEMS optical component further comprises:

a corresponding first hinge configured to pivotally couple the element structure to the insulating layer;

a corresponding support arm, a corresponding second hinge, and a corresponding third hinge configured to moveably couple the element structure to the corresponding actuator mechanism, the corresponding second hinge being configured to pivotally couple a first end of the corresponding support arm to the corresponding actuator mechanism, the

corresponding third hinge being configured to pivotally couple a second end of the corresponding support arm to the element structure.

15. The optical network of claim 15 wherein each of the MEMS optical components is monolithically fabricated on the integrated MEMS chip.

16. The optical network of claim 13 wherein each of the MEMS optical components further comprises a locking latch assembly, the locking latch assembly comprising:

a corresponding actuator mechanism formed on the insulating layer, the corresponding actuator mechanism being configured to be controllably moved laterally with respect to the insulating layer;

a locking latch pivotally coupled to the insulating layer and moveably coupled to the corresponding actuator mechanism, the locking latch having a slot sized to closely receive a side of the element structure, the locking latch having a lying position parallel to the insulating layer and a locking position in which the slot receives the side of the element structure when the element structure is in the upright position;

wherein, when the corresponding actuator mechanism is controlled to move laterally, the locking latch pivots so as to move from the lying position to the locking position.

17. The optical network of claim 16 wherein:

the element structure assembly of each of the MEMS optical components further comprises:

a corresponding first hinge configured to pivotally couple the element structure to the insulating layer;

a corresponding support arm, a corresponding second hinge, and a corresponding third hinge configured to moveably couple the element structure to the corresponding actuator mechanism, the corresponding second hinge being configured to pivotally couple a first end of the corresponding support arm to the corresponding actuator

mechanism, the corresponding third hinge being configured to pivotally couple a second end of the corresponding support arm to the element structure; and

the locking latch assembly of each of the MEMS optical components further comprises:

5 a corresponding first hinge configured to pivotally couple the locking latch to
 (the insulating layer,

a corresponding support arm, a corresponding second hinge, and a
 corresponding third hinge configured to moveably couple the locking latch to the
 corresponding actuator mechanism of the locking latch assembly, the corresponding second
 10 hinge being configured to pivotally couple a first end of the corresponding support arm to the
 corresponding actuator mechanism of the locking latch assembly, the corresponding third
 hinge being configured to pivotally couple a second end of the corresponding support arm to
 the locking latch.

18. The MEMS optical component of claim 17 wherein each of the MEMS optical
 15 components is monolithically fabricated on the integrated MEMS chip.

19. A MEMS optical component formed on a ⁽¹⁾integrated MEMS chip, the MEMS optical
 component comprising:

a moveable stage assembly comprising:

an actuator mechanism formed on the integrated MEMS chip, the actuator
 20 mechanism being configured to be controlled to move on the integrated MEMS chip;

a moveable stage formed on the integrated MEMS chip and fixedly coupled to
 the actuator mechanism, the moveable stage being configured to be moved on the integrated
 MEMS chip;

an element structure coupled to the moveable stage and comprising an optical

20. An optical device integrated on a ^mintegrated MEMS chip, the optical device comprising one or more MEMS optical components, each of the MEMS optical components comprising:

a moveable stage assembly comprising:

5 an actuator mechanism formed on the integrated MEMS chip, the actuator mechanism being configured to be controlled to move on the integrated MEMS chip;

a moveable stage formed on the integrated MEMS chip and fixedly coupled to the actuator mechanism, the moveable stage being configured to be moved on the integrated MEMS chip;

10 an element structure coupled to the moveable stage and comprising an optical element;

wherein, when the actuator mechanism is controlled to move, the moveable stage moves the element structure.

21. An optical network comprising:

15 one or more optical input sources;

one or more optical output collectors; and

an optical device optically coupled between the one or more optical input sources and the one or more optical output collectors, the optical device being formed on a ^mintegrated MEMS chip, the optical device comprising one or more MEMS optical components, each of the MEMS optical components comprising:

20 a moveable stage assembly comprising:

an actuator mechanism formed on the integrated MEMS chip, the actuator mechanism being configured to be controlled to move on the integrated MEMS chip;

25 a moveable stage formed on the integrated MEMS chip and fixedly coupled to the actuator mechanism, the moveable stage being configured to be moved on the integrated MEMS chip;

an element structure coupled to the moveable stage and comprising an optical element;

wherein, when the actuator mechanism is controlled to move, the moveable stage moves the element structure.

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